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ABSTRACT

Reported is a study that explores the effect on student achievement of diagnostic-prescriptive instructional strategies on preservice elementary education majors (N=43) enrolled in an introductory biology course. Factors of pre-treatment achievement and locus of control were analyzed as well. Units on Mendelian genetics, modern genetics, and evolution were taught to two randomly chosen groups of students. Treatments were identical for the two groups except for the diagnostic-prescriptive materials being tested. Data analysis indicates that achievement increased as students in the diagnostic-prescriptive treatment completed the three units and a final examination. Locus of control was shown to be of minimal importance in determining student achievement. (CS)

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GENERALIZABILITY OF DIAGNOSTIC-PRESCRIPTIVE TEACHING STRATEGIES ACROSS STUDENT LOCUS OF CONTROL AND MULTIPLE INSTRUCTIONAL UNITS

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INTRODUCTION

There appear to be significant problems present in the modern undergraduate education process. This statement is witnessed by well publicized reports of declining test scores, grade inflation, and employer dissatisfaction with the abilities of the bachelor. The source for current problems is recognizable when a comparison is made of the basic requirements of courses (and their instructors) and those of the students. Foremost among the requirements common to most courses are:

(1) enough basic information must be presented to endow the student with introductory knowledge or a working ability within the field;

(2) preparation of course materials must be streamlined as much as possible to assure best utilization of instructor time; and,

(3) student evaluation for the purposes of assigning grades must occur.

In assessing student needs the following requirements are critical; the student needs:

(1) appropriate instruction;

(2) enough time to assimilate the desired amount of information;

(3) a structure by which to organize his thinking about a given subject; and,

(4) constructive feedback occurring early enough and frequently enough to allow him to focus on the desired behavior.

Traditionally, emphasis has been given to the above-stated course requirements. In times past, when the student body was exclusively composed

of the intellectually superior, the traditional disregard of the students' needs was not so obviously detrimental to the education process. However, in current times academically average students are common within the student population. As it is difficult for these students to survive disregard of their academic needs, accommodations to traditional instructional methodologies must now be made.

Herein lies the problem: to identify the instructional strategy which best meets the students' needs for appropriate instruction, organization, and feedback while fulfilling the course requirements of sufficient material coverage, efficiency, and evaluation. The balancing of appropriate instruction with sufficient material coverage is unique to every course, instructor, and class. However, the other student and course requirements can be met in any of several ways. Two diametrically opposite strategies are Keller's Personalized System of Instruction and Bloom's Learning for Mastery (see review by Block & Burns, 1976). The former strategy, which is a student-paced, modified programmed-instruction strategy, would be highly useful in a situation where relatively few students were involved, and it is desirable that each student proceed at his own pace or, possibly, reach different endpoints.

The more common situation at the undergraduate college level involves numerous students each following the same time schedule and responsible for assimilation of the same material. Here, a different strategy is necessary. Use of the initial step of Bloom's Learning for Mastery, development of specific instructional objectives, is gaining popularity among instructors of university courses. This occurs most often in education courses, but is found in other disciplines as well. By utilizing instructional objectives, the instructor is forced to establish a structural framework for the course;

by publicizing his objectives the instructor aids the students in organizing their learning. Thus the second student requirement, a structure is met. If having this structure creates more efficient studying by the student, the first student requirement, enough time, is also indirectly aided. However, this is where instructor attempts to fulfill the identified student needs commonly ceases. One important need remains--that of early and frequent feedback.

Continuing to follow Bloom's strategy by frequent diagnosis of learner problems and prescriptive remediation of these problems would seem to meet the last of the identified student needs. To test the efficacy of this hypothesis, several studies have been conducted. Yeany, Waugh, and Blalock (1979), through use of frequent, short diagnostic measures matched to instructional objectives, but without inclusion of specific remediation, noted a significant rise in student achievement over use of instructional objectives, but without diagnosis. Yeany, Dost and Matthews (1979) conducted a follow-up study using instructional objectives, diagnostic measures, and corresponding remedial instruction. They noted a 10% increase in student achievement in the study group over the control group which used the same instructional objectives but which was not exposed to the diagnostic-prescriptive teaching strategy. The increased study group achievement was primarily in low level (i.e., recall) learning.

The present study seeks to expand upon the prior research. Again using an introductory biology class (the same course as in the previous two studies), a diagnostic-prescriptive strategy will be employed in the teaching of three instructional units. Student achievement will be analyzed as will such potentially influencing factors as pre-treatment achievement and locus of control.

Locus of Control (LOC) is studied in conjunction with student achievement to test the hypothesis that student response to the prescriptive remediation will be governed by the degree of internal or external directedness of the individual's nature. It is hypothesized that the internal student allows his locus of control to guide his behavior while the external student operates under the belief that outside factors determine his welfare. In pertinance to classroom behavior, it would be suspected that the internal student would respond more effectively to suggestions as presented by diagnosis and feedback. The student who allowed his external locus of control to dominate his response in the classroom would be expected to respond to a lesser degree due to the belief that his own actions are of little importance in determining the outcome of his tenure in the classroom.

This parameter was also studied by Yeany, Dost and Matthews (1979). In that study it was concluded that the LOC had no significant effect on student achievement and showed no aptitude by treatment interaction. However, it was unknown if this was due to actual insignificance of the parameter or to use of an instrument (Rotter, 1966) for assessing LOC which was not appropriate for the undergraduate college population. Hence, LOC is assessed in this study with the James instrument (Lefcourt, 1976) which was judged by the authors to be more valid for measuring differences which are reflected in the student behaviors.

Hypotheses

The following statistical hypotheses were tested:

H_{01}: **Undergraduate students who are provided with performance objectives and who experience objective-related diagnostic testing with immediate feedback of achievement results will not achieve differently on summative tests from students who are provided with performance objectives but do not experience diagnostic testing.**

H_{02}: Externally-directed students will not achieve differently when compared to internally-directed students.

H_{03}: There is no differential effect of the treatment across the student locus of control levels.

PROCEDURES

Subjects

The subjects were 43 pre-service elementary education majors enrolled in an introductory biology course. The course was split into two sections, each of which was taught at a different time and by a different instructor. One section was randomly chosen as the treatment group while the other section served as a control group for this experiment. Both sections used the same facilities and all materials were identical except for the diagnostic-prescriptive materials being tested. Possible bias existed in the assignment of students to sections in that students stated a section preference during pre-registration. However, any such bias was reduced by computer assignment of students to sections on a first-come, first-served basis. When the section requested by the student was filled, the student was automatically assigned to the other section.

Treatment

Three pre-treatment units were taught. Each instructor taught his own section during the pre-treatment period. Three additional units were taught during the treatment program. One instructor taught the first unit (Mendelian Genetics) to both sections while the other instructor taught the second unit (Modern Genetics) to both sections. Each instructor taught the third unit (Evolution) to his own section. The experimental conditions for the treatment and control group were defined as follows:

Control Group: The usual instructional procedures for the course were followed. Performance objectives were designed to guide instruction, to aid students in organizing the course material, and to provide a basis for evaluation of students. The instructional procedures followed for each of the experimental units are shown in Table 1.

A summative examination, keyed to the objectives, was given following the completion of each unit. A comprehensive examination, covering material presented in all three treatment units and also keyed to the objectives, was administered one week after completion of the third treatment unit.

Treatment Group: Students in this group were subjected to the same instructional protocol as those in the control group. They also completed daily diagnostic measures keyed to the objectives taught the preceding day. Individual remedial assignments were prescribed when the student failed to show mastery of the objective on the diagnostic test. The diagnostic testing was performed at the beginning of each class period; while the students were engaging in the class activities the tests were scored and, at the end of the period, pre-written assignments were distributed to those students needing remediation. Thus, feedback was immediate. The remediation assignments were intended to be completed outside of class time. The students were tested again the following day on objectives not mastered during the original diagnosis as well as on objectives slated for initial diagnosis on that day. If a student failed to show mastery of the objective during the second diagnosis the student was advised to meet with the instructor for individual tutoring.

Prior to the beginning of the treatment program a file of items was written to measure each objective. These items were used on the diagnostic and summative tests; once used on a diagnostic test the item was not re-used. Thus item familiarity to the treatment group, an internal threat to

Table 1

	Experimental Unit 1	Experimental Unit 2	Experimental Unit 3
# of Lecture-Discussion Sessions	4	4	4
# of Objectives Covered/ Sessions	8	8	20
# of Laboratory Sessions	1	1	2
# of Homework Assignments	2	2	1
Media Presentations	1 film	1 film	1 film
Classroom Time	8 hours	8 hours	8 hours

validity, was avoided. Also, prior to the beginning of treatment, a series of remediation assignments was constructed. Each remediation assignment included a textural presentation of material related to a specific objective; this presentation differed from both the course text and the instructor's lecture in order to provide the student a new viewpoint and to hopefully aid in clearing up whatever learning difficulties existed. The remediation assignments for objectives which required problem solving ability included sample problems for student practice.

Data Collection

Three sets of data were collected from each group for analysis. The first set was the student scores on the examinations for each of the pre-treatment units.

The second data set was the Locus of Control scores for all students from both groups. Students with scores ≥ 43 (out of a possible 90) were defined as being externally directed; a score of < 43 identified the student as being internally directed. This distribution is similar to that found by Rotter [reported in Lefcourt (1976)]. The mean LOC score was 43.19 with a standard deviation of 11.66. There was no significant difference ($\alpha = .05$) between the LOC scores of the control and treatment groups.

The third data set was comprised of post-treatment student scores on summative examinations for each of the experimental units and a final examination designed to measure retention across the experimental units. All of the pretreatment and post-treatment unit exams and the final examination were objective reference, multiple choice, and identical for both groups.

Experimental Design

The basic design for this study can be diagrammed in the Campbell and Stanley notation as follows:

$$O_1 \quad O_2 \quad X_A \quad O_3 \quad X_C \quad O_4 \quad X_E \quad O_5 \quad O_6$$

$$O_1 \quad O_2 \quad X_B \quad O_3 \quad X_D \quad O_4 \quad X_F \quad O_5 \quad O_6$$

where: O_1 = pretreatment achievement

O_2 = LOC test

X_A = objectives-only instruction in Mendelian Genetics

X_B = objectives plus D-P instruction in Mendelian Genetics

O_3 = unit test for Mendelian Genetics

X_C = objectives-only instruction in Modern Genetics

X_D = objectives plus D-P instruction in Modern Genetics

O_4 = unit test for Modern Genetics

X_E = objectives-only instruction in Evolution

X_F = objectives plus D-P instruction in Evolution

O_5 = unit test for Evolution

O_6 = retention measure for the three experimental units

Data Analysis

Analysis of variance and analysis of covariance, using pre-treatment scores as the covariate, were performed. The ANCOVA procedure did not yield an increased power or lead to drastically adjusted group means, hence the results of the simpler ANOVA procedure will be discussed here. All hypotheses were tested at the $\alpha = .05$ level.

RESULTS

The analysis indicated that the diagnostic-prescriptive treatment had differing effects on student achievement in the different experimental units. There was no significant difference in achievement between the treatment and control groups in the first experimental unit (Mendelian Genetics). However, there was a significant increase in achievement by the students in the treatment group in the second and third experimental units (Modern Genetics and Evolution). The students in the treatment group also scored significantly higher on the final exam than did the control group students (see Tables 2 and 3).

The locus of control of the students was shown to be of minimal importance in determining student achievement. The parameter proved insignificant on all measures except the Evolution Unit Test where it was found to be significant at $p = .053$. There was no significant LOC x treatment interaction.

DISCUSSION

The results indicate that the use of diagnosis with remediation leads to increased student achievement. This increased achievement was expressed on unit tests and on a comprehensive final exam indicating that retention of learned behavior was improved.

A phenomenon noted in the Yeany, Waugh, and Blalock (1979) study was repeated in this study. The experimental methods were used in a series of units. The control and treatment group showed no significant differences in achievement in the first experimental unit; but, the treatment group did show increased achievement in subsequent units. This indicates that, in

Table 2

Results of 2-way ANOVA to Test the Effects of Treatment and Locus of Control on Retention and Achievement Across Three Instructional Units

	Unit I		Unit II		Unit III		Retention	
	F	p	F	p	F	p	F	p
Treatment	.53	.47	5.7	.02	10.1	.003	14.1	.001
LOC	.52	.48	1.4	.24	3.9	.053	.06	.81
Interaction	.019	.89	.30	.58	.09	.77	.1	.96

Table 3

Achievement Means for the Experiment and Control Groups Across Three Units of Study and A Retention Measure

	Unit I	Unit II	Unit III	Retention
	$\bar{X}$	$\bar{X}$	$\bar{X}$	$\bar{X}$
Experimental	40.5	39.4	40.14	175.5
	$\bar{X}$	$\bar{X}$	$\bar{X}$	$\bar{X}$
Control	39.7	35.6	35.5	160.1

order to benefit from the teaching strategy, the students must first become fully acquainted with the diagnostic-prescriptive process.

The student locus of control does not appear to influence behavior. This finding corroborates the findings with regard to LOC in the Yeany, Dost, and Matthews (1979) study. Hence, it is concluded that, in the type of learning involved in this study, the external student may override this basic character and respond to outside suggestions about his learning habits.

The increases in achievement demonstrated by the treatment group were 10% and 13% on the significant unit measures while the achievement increase on the retention measure was 9%. The authors feel that this sizeable increase is worth the extra instructor time spent in preparing the diagnostic test items. It is noted that the cost of this procedure in terms of instructor time diminishes drastically upon repetitious use of the strategy, as the materials can be reuse in subsequent offerings of the course.

A question must, however, be raised in light of the time factor involved in preparing remediation materials as used in this study. Yeany, Waugh, and Blalock (1979) also noted an increase in student achievement following a similar diagnostic testing program but not prescribing remedial assignments. Achievement increases in a diagnosis only program versus increases due to diagnosis plus remediation need to be assessed. With this knowledge it will then be possible to decide the proper course to follow in regard to cost (instructor time) and benefit (student achievement).

REFERENCES

Block, J. H. & Burns, R. B. Mastery learning. In L. E. Shulman (ed.), Review of Research in Education. Itasca, IL: F. E. Peacock, 1977.

Lefcourt, H. M. Locus of control: Current trends on theory and research. Hillsdale, NJ: Lawrence Erlbaum Associates Publishers, 1976.

Rotter, J. B. Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs: General and Applied, 80(whole no. 609), 1966.

Yeany, R. H., Waugh, M. L., & Blalock, A. L. The effects of achievement diagnosis with feedback on the science achievement and attitude of university students. Journal of Research in Science Teaching, 1979, 16(5), 465-472.

Yeany, R. H., Dōst, R. J., & Matthews, R. W. The effects of diagnostic prescriptive instruction and locus of control on the achievement and attitudes of university students. Journal of Research in Science Teaching, 1980, (in press).